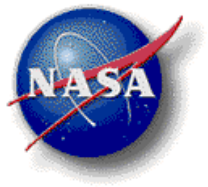
CTSD-JWT-0064

Requirements & Specifications for the Replacement of the Cryogenic Helium Distribution Lines

Engineering Directorate

Crew and Thermal Systems Division

January 20, 2011



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CHANGE LOG

Listed below is the current revision level for this document.

REVISION LEVEL	REVISION DESCRIPTION	DATE
Basic	Original Issue	20 January 2011
Revision A	Title: Changed Refurbish to Replace Sec 2.1 Clarification on male bayonet, RV-80, and added supply pipe summary. Sec 2.2 clarification on valves and RVs and added, Return piping summary. 3.6 Re-written for clarification. 3.9 Removed drawing formats. 3.9.2.3 Changed/clarification for allowance of field weld or field bayonet. 3.9.3.3 and 3.9.3.4 added RV requirements 3.9.4.1 Clarification for male bayonet. 3.9.4.2 New requirement if using horizontal bayonet. 3.10.1 Added TRR	25 April 2011

Requirements for the Chamber A helium distribution to the cryo-pumping panels refurbishment

1.0 Objective: The objective of the Chamber A Replacement of the Helium Cryo-pumping panel distribution is to improve the performance of the cryogenic distribution lines that were part of original chamber design. These lines have multiple vacuum leaks and have degraded in heat loss performance over the years. The Systems Test Branch at NASA Johnson Space Center is responsible for the operation and maintenance of the test laboratories. The Systems Test Branch (EC4), is part of the Crew and Thermal Systems Division (EC), under the Engineering Directorate (EA) at JSC.

2.0 SCOPE: The scope of the work on this project is the following:

2.1 Replace original supply line from B32 room 1904 to Chamber A inlet manifold

2.2 Replace original return line from the interface at Chamber A to the B32 room 1904.

2.1 Supply Line

The supply line is a 2” process line with a 4” vacuum jacket. It will start with a female bayonet (currently just a cap) in room 1904 and tee into a connection with the valve CV-17D on the chamber side of the wall. A male bayonet with a test port shall be delivered with the female. It continues towards chamber A traveling up to the second floor and crossing over the first floor man-locks. Above the man-locks is CV-17A, this valve will be removed and not replaced in this location per the new P&ID but it will be reused elsewhere and should be retained in good condition. The line then splits or tees to supply both Chamber B and the input to CV-17 on the Chamber A system. This line and CV-17 (with RV-80) will be replaced (This valve shall be replaced with the valve previously used as CV-17A). After CV-17, the supply line will be replaced up to the point where it splits for the main supply manifold (CV-1, 3, 5, 7, 9, 11, 13, & 15).

Figure 1. P&ID

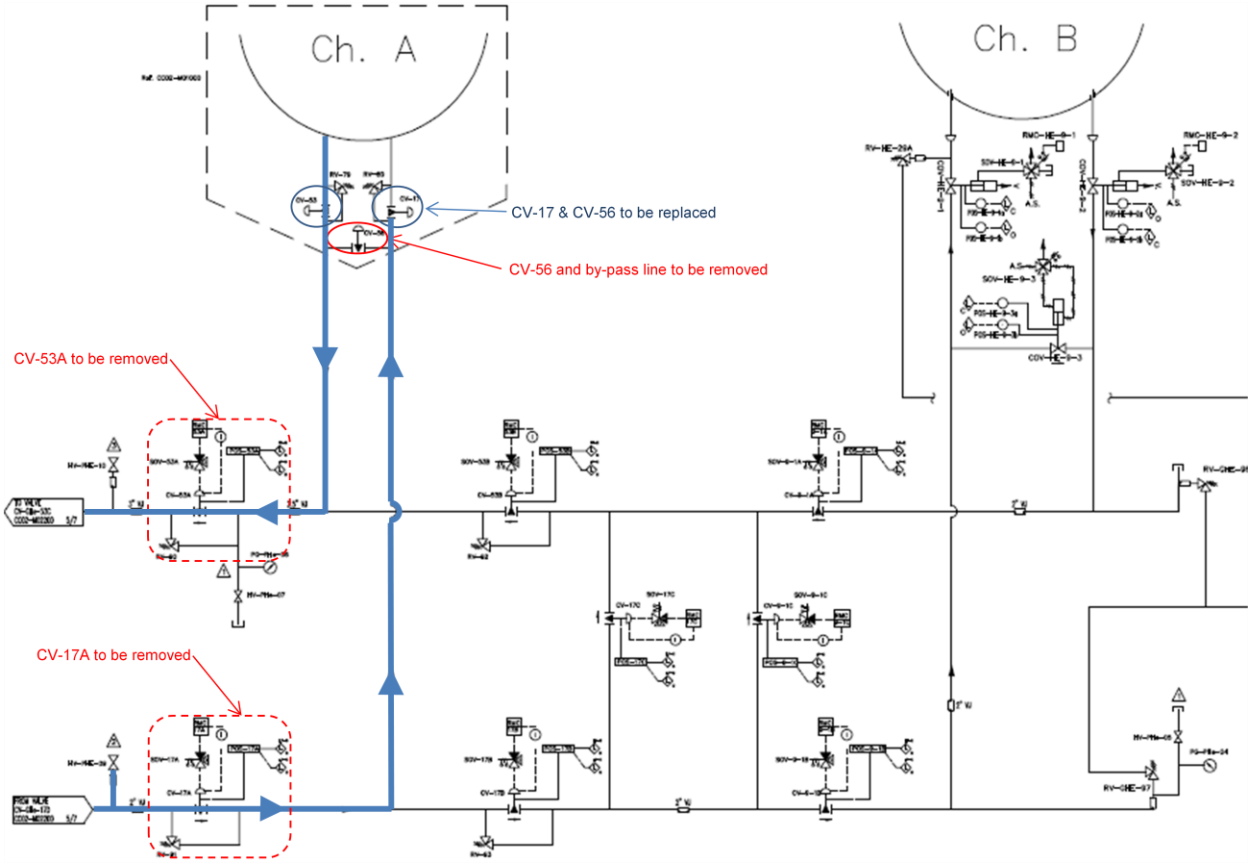
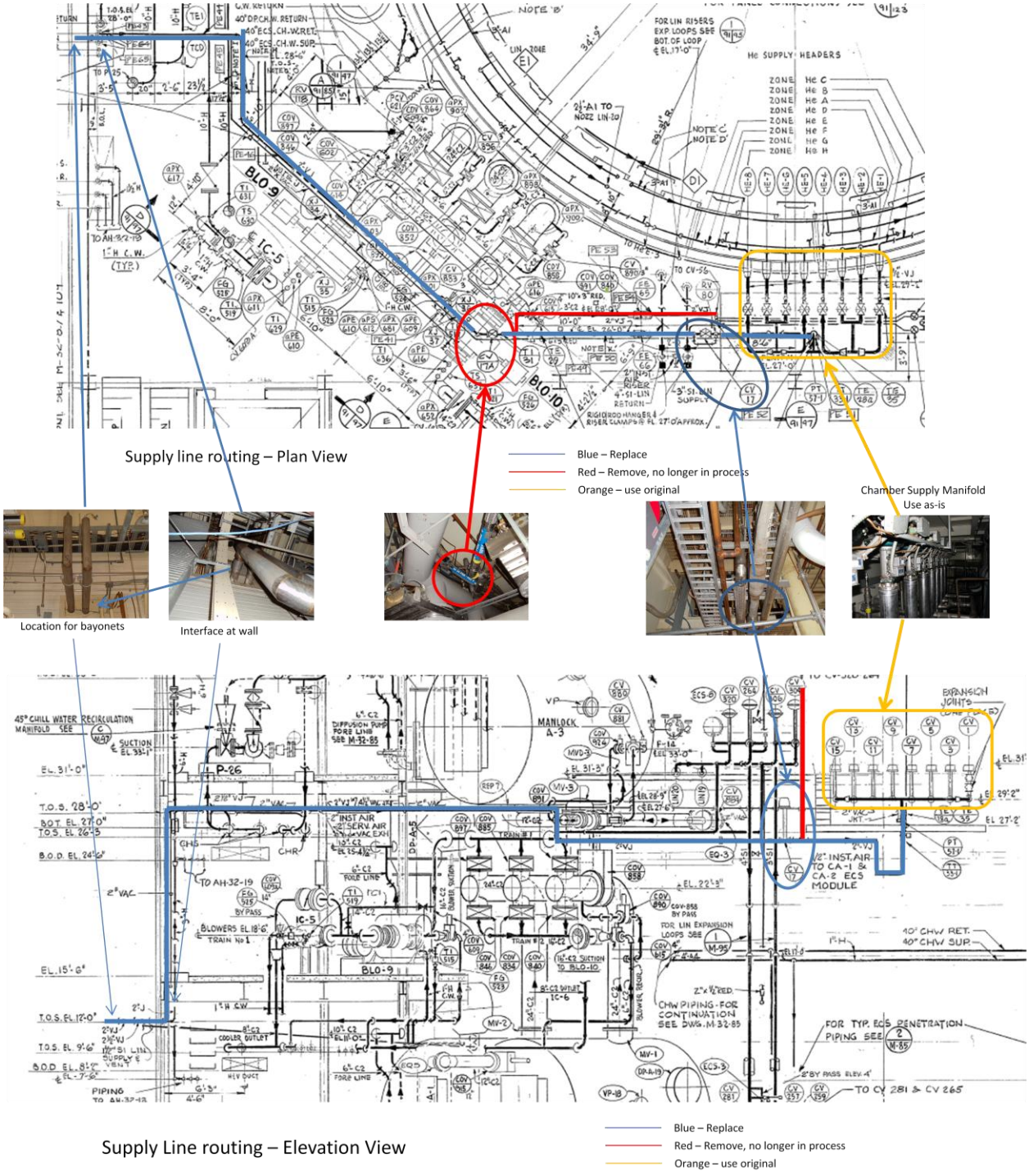


Figure 2. Supply Line Routing



Supply Piping Summary – Need field verification:

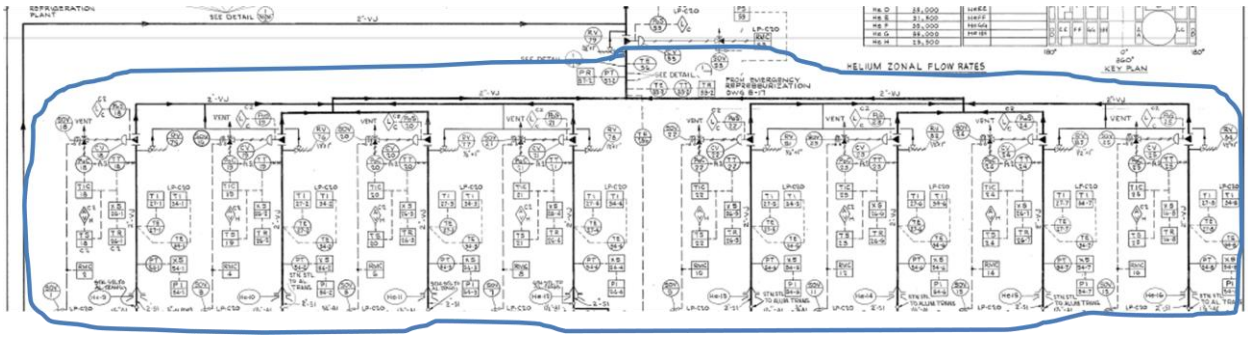
- Approximately 100 ft of 2” process VJ line.
    - Nine (9) 90 degree bends
    - Two (2) 45 degree bends
    - Two (2) “Tees”
- Valve CV-17 and Relief Valve RV-80
- Interfaces:
    - Starting – 2” female bayonet with male bayonet with test port
    - First floor – at “Tee” through room 1904 wall to CV-17D. This is a cut and repair of existing spool.
    - Second floor - below “Tee” that interfaces with bayonet connection to Ch-B supply. This bayonet will be given to contractor.
    - Second/Third floor – at bottom of floor to supply manifold / Top of expansion “U.” This is a cut and repair to the existing spool.

2.2 Return Line

The return line will have more extensive modifications than the supply line

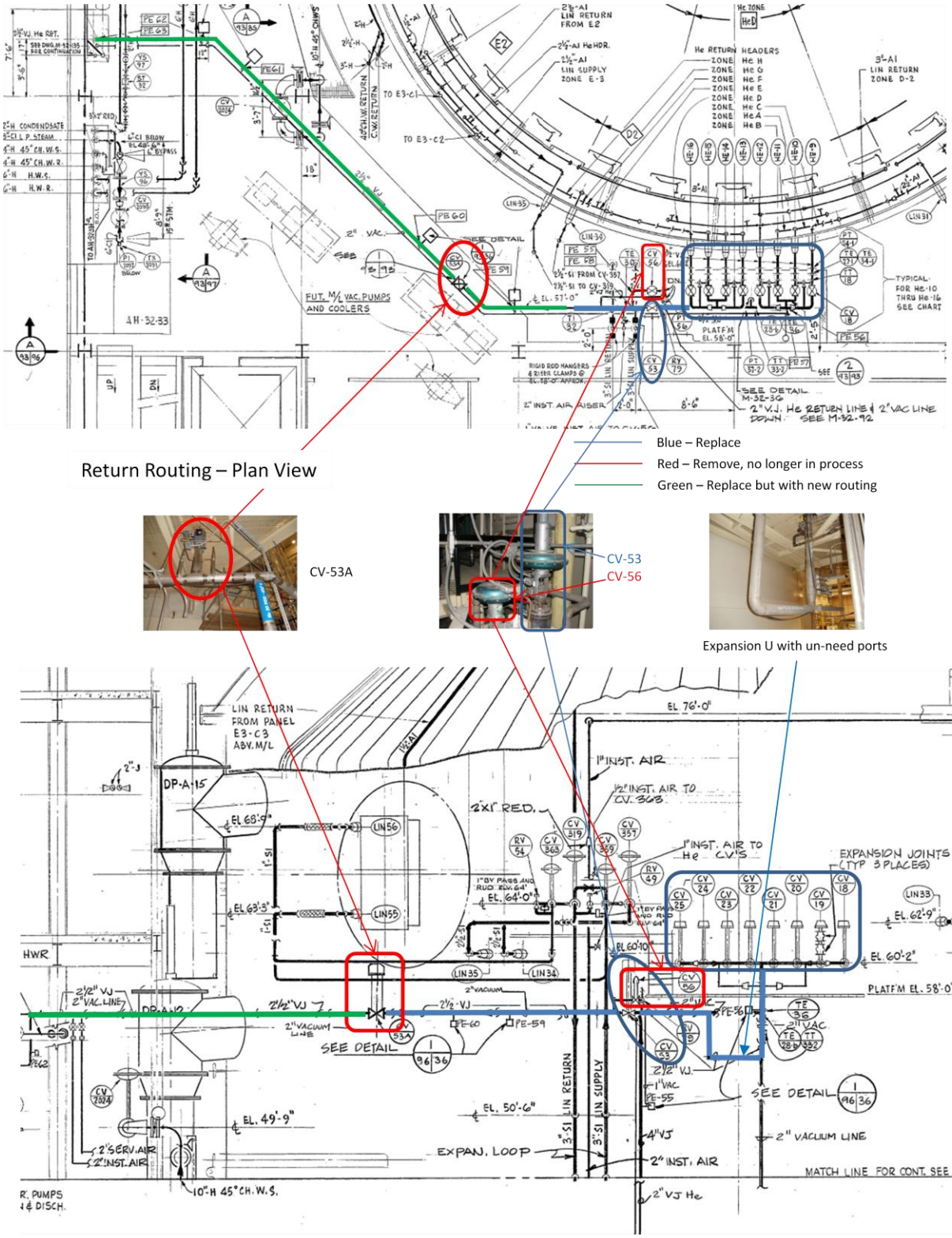
- First the manifold at the chamber for the zone return shall be completely replaced. This includes removal and replacement of valves (CV-18, 19, 20, 21, 22, 23, 24, 25) and their corresponding relief valves for thermal expansion (RV-75, 76, 77, 78, 81, 82, 83, 84). The manifold will be simplified and the valves replaced with low temperature helium service valves. The current instrumentation ports shall be removed and not replaced.

Figure 3. Outlet Manifold P&ID & Picture, 5th level of chamber.



- Second, the return line from the manifold in the section above to the first floor shall be replaced and re-routed. This is a 2.5” process line with a 4” outer vacuum jacket.
- Valve CV-53 and its relief valve (RV-79) shall be replaced.
- The return will end in room 1904 next to the supply with a 2.5” female bayonet, with a male bayonet provided. The male bayonet shall be fitted with a test port.

Figure 4. Return Line Routing



Return Piping Summary – Need field verification:

- Approximately 127 ft of 2.5" process VJ line.
  - Eight (8) 90 degree bends
  - Two (2) 45 degree bends
  - Two (2) "Tees"
- Valve CV-53 and Relief Valve RV-79. All Tees and 90's to bypass valve. (RV-79 is ¾"x1" with a set of 30 PSID).
- Interfaces:
  - Ending – 2.5" female bayonet with male bayonet with test port
  - First floor – at "Tee" through room 1904 wall to CV-53C. This is a cut and repair of existing spool.
  - Fourth floor - "Tee" that interfaces with bayonet connection to Ch-B return. This bayonet will be given to contractor.
  - Connect to new return manifold
- Return Manifold – 2" process piping
  - Eight (8) 2" connections to chamber vacuum interface
  - Eight (8) 2" Equal Percentage control valves
  - Eight (8) Relief Valves (½" x 1", 30 PSID)
    - Corresponding piping to allow RV bypass of control valves
  - Eight (8) 90 degree bends
  - Eight (8) 2" "Tees"
  - One (1) 2" to 2.5" Tee to expansion "U"

3.0 General Requirements:

The following are the general requirements and specifications for repairing the current helium cryo-pumping panel distribution lines around chamber A:

3.1 These lines are used to achieve high vacuum (<1x10-5 Torr) within chamber A.
3.2 The process fluid is gaseous helium:
3.2.1 MAWP 150 PSIG
3.2.2 Minimum pressure - Full vacuum
3.2.3 Maximum Operating Temperature: 330 K (135 F)
3.2.4 Minimum Operating Temperature: 10 K (-442 F)
3.3 All process and vacuum piping shall be made of seamless 300 series stainless steel piping (preferably SA312 SMLS 304/304L dual grade stainless, or 316/316L dual grade SS).
3.4 All piping shall be a minimum of schedule 10S wall thickness.
3.5 The process piping shall be designed, fabricated, inspected, and tested in accordance to ASME B31.3 to the pressures and temperatures in 3.2.
3.6 The outer vacuum jacket piping shall be designed and built to the B31.3, but does not require pressure testing per B31.3 like that of the internal process piping.

3.7 The vacuum insulation shall keep the outer surface of the vacuum piping within 3K (5F) of the ambient air temperature when the process piping is at minimum temperature. This shall include a minimum of 30 layers of super-insulation (MLI), and G10 or approved equivalent for mechanical spacers.

3.8 Each vacuum jacket shall be equipped with a vacuum pump-out port with a removable vacuum readout gauge (Teledyne Hastings DV-6) and pressure relieving device.

3.8.1 Pump out valve to interface to pump out ports must be provided.

3.8.2 The pressure gauge shall be a Teledyne Hastings DV-6 to match what is currently configuration.

3.8.3 The pressure relieving device shall be designed for catastrophic release. It shall not be a calibrated relief valve, but designed to relieve at ~ 1-5 psid to atmosphere (Parallel plate, or flap), and shall hold pressures below 1x10-6 Torr with a leak undetectable at 1x10-9 mbar-liter/sec of helium.

3.9 Piping design

3.9.1.1 The seller is responsible to field measure and verify all pipe lengths and fit-up.

3.9.2 The seller shall produce all spool, and installation drawings.

3.9.2.1 The drawings shall be reviewed and approved by the COTR prior to fabrication.

3.9.2.2 The design for mechanical support shall use existing structure for pipe support. Existing pipe hangers or locations may be re-used if acceptable by flexibility analysis.

3.9.2.3 The design may use field weld or bayonet for field installation and approval given by COTR at the PFR for final design.

3.9.3 Control Valves

3.9.3.1 The sizing of Valves CV-18, 19, 20, 21, 22, 23, 24, 25 shall be verified with existing valves and shall be replaced with equal percentage valves of equivalent size. Current information notes that they are 2", but this must be verified.

3.9.3.2 The valves must be approved by the COTR prior to seller purchasing.

3.9.3.3 All relief valves shall set to relieve at 30PSID.

3.9.3.4 Relief valve shall be removable for calibration. VCO fittings shall be used for removal. All threaded connections shall be made with an epoxy approved by the COTR.

3.9.3.5 The seller must disassemble and remove all soft goods prior to welding valves to spools.

3.9.3.6 The valves must be cleaned to GC level and re-assembled with new soft goods as recommended by the valve manufacturer (bonnet gasket, etc.)

3.9.3.7 Control Valve Electrical Design Requirements:

3.9.3.7.1 All control valves shall have an electro-pneumatic positioner, loop powered, accepting a 4-20 mA(DC) positioning signal. Positioner to include pressure gauges and filter.

3.9.3.7.2 All valves shall be provided with position feed back, 4 – 20 mA (DC) loop powered.

3.9.3.7.3 Valve operators shall be instrument air actuated. Facility instrument air provided by the buyer is regulated between 80 to 100 PSIG. All the mounting brackets and attachment to valve shall be provided.

3.9.3.8 Provide pressure reducing regulators to regulate facility instrument air to valve operators

3.9.3.9 All valves to have a needle valve on the actuator air circuit for stroking rate adjustment.

3.9.3.10 NEMA enclosures are required for all electrical devices.

3.9.4 Bayonets

3.9.4.1 The bayonets in room 1904 will be vertical and axially aligned. They will be of the CVI design equivalent and must be approved by the COTR. The new process lines will include the female, and males shall be provided with designed in test ports.

3.9.4.2 If field bayonet design is used, all horizontal bayonets shall be dissimilar coefficient of thermal expansion metals to tight fit the female on the male at cryogenic temperatures. These shall be reviewed and approved by the COTR. All bayonets shall be helium leak checked per ASTM E499.

3.9.5 Pipe supports

3.9.5.1 The design and installation of all pipe supports shall be reviewed and approved by the COTR.

3.10 Vacuum Performance and testing

3.10.1 The process piping shall be pneumatically tested using MIL spec B Nitrogen gas (MIL-PRF-27401E) or better and documented in accordance with ASME B31.3.

3.10.1.1 Final pressure test requires a NASA Test Readiness Review.

3.10.2 All process piping shall be helium leak checked and leakage shall be undetectable at 1x10-8 mbar-liter/sec.

3.10.3 The final product shall not require active pumping to maintain acceptable vacuum insulation levels.

3.10.4 All vacuum piping shall maintain a vacuum level of 10 milliTorr or better for 1 year after acceptance.